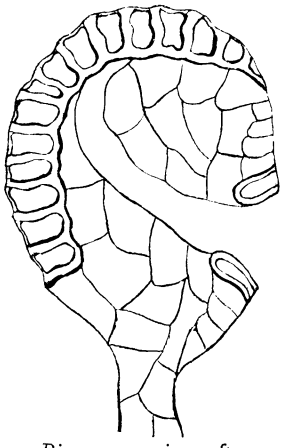
Dehiscence of the Sporangium of Adiantum pedatum.*

BY FLORENCE MAY LYON.

The sporangia of *Adiantum pedatum* are fixed by slender stalks to the under surface of the pinnule whose reflexed margin forms the indusium. Each sporangium consists of a flattened, somewhat obovate sac. Its walls, consisting of a single layer of cells, are—with the exceptions given below—composed of pure cellulose. Extending vertically about two-thirds around the sporangium is the annulus. The walls which separate adjacent cells of the annulus, together with the floor of each cell, are much thickened and lignified, while the external wall, which curves over the edge of the sporangium in such a manner as to form a half cylinder, is a thin membrane of cellulose. In the remaining one-

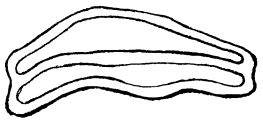


Ripe sporangium after expelling spores.

of the circumference, about midway between the end of the annulus and the stalk, are two narrow and elongated cells with thick lignified walls. It is between these two cells, along a definite line, that dehiscence always begins. That this is the point of greatest weakness is evident from the fact that if an unopened ripe sporangium be put into Schulze's macerating fluid, almost immediately, and before any other rupture is seen, these two lip-cells gape apart. The same result may be produced by strong potash. Moreover, the margins of the slit are clear cut, and never jagged, as if torn.

These two cells seem to have been overlooked hitherto, or to have been considered of no importance, for they are rarely represented in the cuts of fern sporangia, and dehiscence is described as taking place transversely, somewhere or anywhere between the end of the annulus and the neck. The constancy of this structure in the sporangia of the true ferns seems to indicate its importance. In the ferns mentioned below, I have found these modified cells, with slightly varying details of structure, and have

* Read before the Botanical Club, A. A. A. S., New York, Aug., 1887.

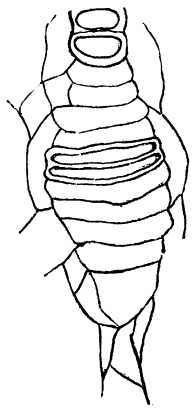


Front view of "lip cells."

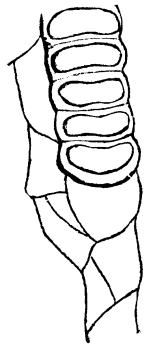
observed that dehiscence invariably begins by the clear cut between the lip-cells, and then continues as a somewhat irregular rent through the thin walls back to the annulus. The material from which the above results were obtained was preserved in alcohol. Fresh plants of *Adiantum Capillus-Veneris* and of *Pteris cretica* were obtained from the greenhouse, the remainder were dried specimens from the herbarium.

The species in which the lip-cells were observed are the following: *Adiantum Capillus-Veneris, Pteris cretica, Asplenium bulbiferum, A. Filix-fœmina, Aspidium Filix-mas, Polypodium vulgare, Scolopendrium vulgare, Woodwardia Virginica, Woodsia obtusa, Camptosorus rhizophyllus, Pellæa atropurpurea* and *Struthiopteris Germanica.*

Although in general the action of sporangia preserved in alcohol was satisfactorily studied, the results obtained remain to be verified from fresh specimens. If a sporangium be allowed to dry upon the slide, simultaneously with the appearance of the rent between the lips the annulus bends back until the ends nearly touch; then, with a quick jerk, it resumes its former position, expelling the spores by both movements. Then the annulus once more, but more slowly, straightens, generally coming to rest in an almost rectilinear position. The same phenomena may be observed more easily if the sporangium be placed in glycerine and the movements somewhat retarded by the pressure of the cover glass. As the annulus recurves the first time, the lateral walls of each cell, which in optical section appear like the letter U, approach each other, and the thin outer wall is pressed in so that the cavity of the cell is much diminished in size. At the



Front view of the portion of the sporangium lying between the stalk and the upper end of the annulus.



Portion of the annulus adjoining the stalk.

moment that the annulus returns to its original position, a bubble of air makes its appearance in each of its cells. The sporangium when in glycerine rarely comes to rest so widely open as when dry.

Now, first, what is the initial cause of the arching back of the annulus? Second, why does it return to its former position? Third, why does it finally assume the rectilinear position? The ordinary explanation is that the ring is elastic or hygroscopic. This is plainly unsatisfactory. It has been suggested by a late writer* that there is greater contraction of the thin external wall which thus pulls the annulus back. This explanation is disputed in a more recent paper by M. Leclerc du Sablon.† He argues that the external wall does not become tense as it would were it to contract more rapidly, but, on the contrary, sinks almost to the floor of the cell. Schinz offers still another solution, i. e., that the lignified walls are not homogeneous; that the inner layers contain more water and consequently contract more upon drying than the external ones, and that to this unequal contraction is due the initial movement of the annulus. M. du Sablon objects to this on the ground that if the annulus be separated from the sporangium and cut through lengthwise, each half ought to act precisely like the ring when intact. He claims to have made this section, but the half ring failed to contract. M. du Sablon's own explanation is substantially as follows: "The dry air surrounding the sporangium causes the water contained in the cells to evaporate. The pressure of the surrounding medium is greater than the pressure inside the cells, and the delicate external wall is pushed in, which accounts for the concave appearance. The cells of the entire annulus being thus depressed, cause it to straighten and curve backward." So far we can offer no criticism, although the explanation is purely hypothetical. He explains the return movement, however, in a very unsatisfactory manner. He believes it to be caused by the sudden formation of bubbles of air in the row of cells constituting the annulus, which, according to his belief, increase the internal pressure sufficiently

* SCHINZ.—Untersuchungen über den mechanismus des Aufspringens der Sporangien und Pollensäcke. Zurich, 1883.

† Recherches sur la dissemination des spores chez les Cryptogames vasculaires. Ann. des Sci. Nat., Sér. VII., Tom. II.

to restore each cell to its original size, and thus throw the ring back to its original position. He thinks the bubble is formed of the air contained in the cell sap. If this be the case, as the amount of air is a very small per cent. of the cell contents, even should it expand, its pressure could not be so great as that of the surrounding denser air. It is difficult, moreover, to understand why the air in the cell should expand, as there is no diminution of external pressure nor any rise of temperature. The third movement he accounts for by the further evaporation from the cells.

A clear explanation of the causes which produce the dehiscence in the fern sporangia remains to be worked out. The presence of the lip-cells here described, of the existence of which M. du Sablon's figures and descriptions give no recognition, may prove an important factor.

BOTANICAL LABORATORY UNIVERSITY OF MICHIGAN, June, 1887.

[For other notes on this subject see the BULLETIN xiii, p. 168, ; Ber. Deutsch Bot. Gesell., iv, p. 42 ; Journ. Roy. Mic. Soc. 1886, pp. 828 and 1020 ; 1887, p. 662 ; and Flora, lxx, (1887) pp. 177, 192, 202-208.—ED.]

Notes on the Flora of Cayuta Creek.

Being stationed for a few weeks at Waverly, N. Y. (Tioga Co.), near the mouth of this stream, I determined to work up its bed and shed as far as possible, it being an especially interesting locality to me, as it geographically connects my work in Broome Co. with that of Dr. Lucy in Chemung Co., and of Prof. Dudley in the Cayuga Lake Basin. This little rivulet, having its source in a small lake by the same name situated a little south of east of the head of Seneca Lake and between it and Cayuga, flows southeast for half its length and then mainly south to its junction with the Susquehanna river, just across the Pennsylvania State line, a little east of the center of the southern tier of counties. This stream is about 35 miles long, flows through a narrow valley whose hillsides are mostly cleared and form fine farm lands, and forms a natural county line between Schuyler and Tompkins on the north, and Chemung and Tioga on the south.* Thus far we

* Those who are fortunate enough to possess Prof. Dudley's "Cayuga Flora," will find a quite faithful map of this location as a frontispiece.